UCRL-JC-119461 Abstract

Physical Basis of Phase and Spectral Ratio Discrimination at the Nevada Test Site

William R. Walter, Kevin Mayeda, Peter Goldstein and Howard J. Patton, Lawrence Livermore National Laboratory, Earth Sciences Division, L-205, Livermore, Ca., 94551

Combined phase ratio (P/S) and spectral ratio (low/high frequency) discriminants can separate most Nevada Test Site (NTS) earthquakes from explosions in a set of near regionally recorded events between magnitude 2 and 6 (Walter et al., 1995). To understand the physical basis of the discriminants we isolate the source and path contributions. To examine path effects we compare earthquake-explosion pairs that have epicenters within 5 km of each other. These event pairs show the same differences as observed in the dataset as a whole. Turning to source effects, source functions obtained by empirical Green function deconvolution in the OSSY and NPE experiments (Goldstein et al., 1994; Goldstein and Jarpe, 1994) share the same frequency dependence as P_n spectra corrected for distance. We generalize these results and interpret the distance corrected P_n spectra as the source function spectra. The explosion source spectra show dependence on the source material properties, but not on depth. The high gas porosity explosions have significantly less high frequency energy in the source spectra than either low gas porosity explosions or earthquakes of the same magnitude. Low gas porosity explosions and earthquakes appear to have similar source spectra. The source medium properties of velocity density and gas porosity are correlated and at present it is unclear which one or combination most affects the source spectrum. Distance corrected L_g/P_n, P_g/P_n and Coda/P_n spectra may be interpreted as L_g, P_g and Coda transfer functions, which reflect different focal mechanism, depth and medium dependent efficiencies of P and Rg scattering and conversion near the source. These transfer functions show significant differences between earthquakes and explosions, most apparent in the Lg and Coda transfer functions above 4 Hz. The success or failure of the discriminants at NTS depend on differences in the source and transfer functions as follows:

P_n Spectral Ratio - Source function differences

P_g, L_g and Coda Spectral Ratio - Source and transfer function differences

Phase Ratios - Transfer function differences.

We are studying regional data at other test areas to explore earthquake-explosion source and transfer function differences in areas outside NTS.

*This research was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract number W-7405-ENG-48.

William R. Walter
LLNL, Earth Sciences Division, L-205
P.O. Box 808
Livermore, CA, 94551 (510) 423-8777

William R. Walter member #12668

Special Session: "Seismology Related to Test Ban Treaty Verification" (S. Taylor convener)

ORAL PRESENTATION